DOCUMENT RESUME

ED 123 133 SE 020 909

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TITLE Interchange. Population Education Newsletter. Volume 5, Number 3.
INSTITUTION Population Reference Bureau, Inc., Washington, D.C.
PUB DATE May 76
NOTE 5p.; Some small print and shaded charts
AVAILABLE FROM Population Reference Bureau, Inc., 1754 N Street, N.W., Washington, D.C. 20036

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Demography; Educational Programs; *Environmental Education; Intermediate Grades; Learning Activities; *Newsletters; *Population Education; Population Trends; *Resource Guides; Secondary Grades; Social Studies

ABSTRACT

This publication is designed to introduce the interdisciplinary nature of population information to educators and centers of population education activity, provide classroom activity suggestions, and to review developments in the effort to infuse population issues into U.S. secondary schools. The publication provides a forum for information and ideas from the Population Reference Bureau, Inc., and from readers. This volume includes discussion of world population as of March, 1976 and current world growth rates, classroom activities for the understanding of demographic measures, birth rate, rate of population growth, infant mortality rate, life expectancy, per capita gross national product, enormity of population figures, concepts of doubling, and exponential growth. Also included are an annotated list of resource materials for classroom population education and a discussion of several state programs in population education. An events calendar of population activities concludes the publication. (RE)

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Population Reference Bureau, Inc.

Population Education Newsletter

Vol. 5 No. 3

inter-change

BEST COPY AVAILABLE

May 1976

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4 Billion and Growing

The world's population reached 4 billion in March 1976 according to the latest estimates of the Population Reference Bureau. The estimates are based on an annual growth rate of 1.8 percent, slightly lower than estimated previously. While it is nearly impossible to comprehend the magnitude of billions of people, the concept of exponential growth conveys the dynamic momentum involved.

Any population or system that grows by doubling, that is, 1, 2, 4, 8, 16, 32 . . . is increasing geometrically or exponentially. Plotting on a graph the change in size of the numbers after a series of doublings results in a curve shaped somewhat like the letter *J*. As in the graph below on Growth Through Time, little change takes place for a long time. Then suddenly the size of the numbers changes enormously, the bend in the *J* is rounded, and the curve becomes nearly vertical.

One way to illustrate the concept of exponential growth is to double a book page over and over again. The total thickness of the layers is noted after each doubling. Assuming that the page is about 0.1 millimeter thick, then after the first doubling the thickness is 0.2 millimeter, then 0.4, 0.8, 1.6, 3.2, and so on. After eight doublings the paper is 25.6 millimeters, or approximately one inch thick. Nothing much has happened. After 12 doublings it is slightly over 1 foot thick and after 20 doublings about 340 feet thick. This still represents only the relatively flat lower part, or lag phase, of the *J* curve.

Thirty-five doublings moves the curve around the bend with a thickness equivalent to 3,000 miles. After that, each doubling increases the thickness astronomically. Just 42 doublings would create a mound of paper stretching from here to the moon 240,000 miles away. In exponential growth, the ever-growing base eventually builds to such large size that each additional doubling represents an amazing increase in the total.[1]

Human population increases exponentially. In 1 A.D. man's numbers were about 250,000. It then took nearly two millennia or about 1,850 years to arrive at the first billion. World population doubled to 2 billion in 1930—after only 80 years. The next doubling to the present four billion occurred within 50 years. If the present 1.8 percent annual growth rate is maintained the world's population will double again in less than 40 years. In terms of the *J* curve model, global population is now well round the bend and heading almost straight up.

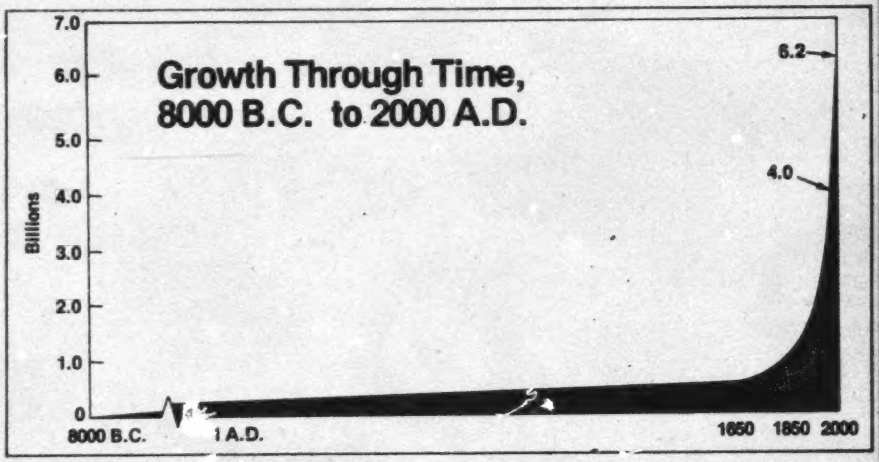
The current growth rate of 1.8 percent may not seem high in itself, but because it is applied to such a large base, it yields a tremendous annual increase in population. The rate of world growth is determined by the difference between birth and death rates. The 1976 world birth rate of 30 births per 1,000 people means that 228 babies are born every minute or 328,000 every day. At the current death rate of 12 per 1,000, 93 people die each minute or 134,000 each day. As a result, 135 people per minute or about 194,000 per day are added to the population. After only one week, the increase is roughly equivalent to the population of Detroit, Michigan.

During the twentieth century, the majority of the world's population has been concentrated in relatively few nations. The ten largest countries now account for about 64 percent of the total population. The list of the top ten countries will have altered significantly by the end of the century. In 1932, the USSR, United States, Germany, Japan, United Kingdom, France, and Italy - all developed countries - were among the largest. By the year 2000, eight of the top ten will be developing countries. Differences in the number of years it takes for populations to double partly explain why country ranking by size can shift so dramatically. Doubling time depends on the growth rate. A population growing at 1 percent will double in 70 years, at 2 percent in 35 years, and at 3 percent in only 23 years.

Changes between 1932 and 2000 in the relative size of the populations of Mexico and the United Kingdom illustrate this clearly. Mexico's population was 16.6 million in 1932, and today is 62.3 million. If the current growth rate of 3.5 percent continues, the population will be over 134 million in the year 2000. In contrast, the United Kingdom had about 46 million people in the early 1930's and 56.1 million in 1976. Having nearly reached zero growth, the population is projected to be only 62.3 million by the turn of the century. Within a period of 70 years, Mexico's population will probably grow from one-third the size of the United Kingdom's to one that is more than double.

Today most developing countries are growing by at least 2 percent a year, while most developed countries are increasing by less than one percent. The shifts in the ten largest countries between 1932 and 2000 (see Table inside) should not be surprising given differing rates of growth.

The world's population is expected to be over 6 billion at the turn of the century if current growth rates continue.



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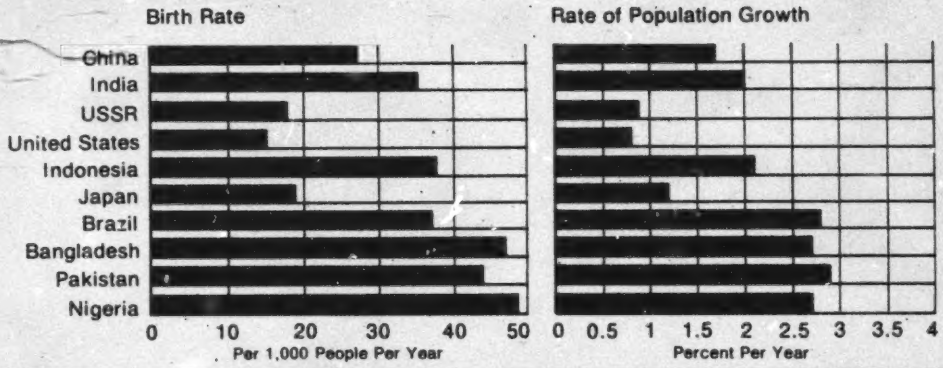
1976 DATA FOR THE WORLD'S TEN LARGEST COUNTRIES



Source: 1976 World Population Data Sheet, Population Reference Bureau, Inc.

This means that 58 percent more people will inhabit the earth. It is difficult to evaluate the implications of continued rapid increase, although it can't continue indefinitely. No one really knows what an optimum level of population is or how many is too many. However, many countries are already unable to provide their people with adequate food, housing, education, jobs, and services. How they will cope in the future is even more uncertain.

The rate of population growth could decline as it apparently has to some extent in the past few years. More nations are recognizing that problems in all facets of life are intensified by rapid growth. Many have adopted policies and programs to foster development, family planning, and population education. Such a range of efforts may help accelerate a slow down in the world's growth, which will in turn help to broaden the alternative futures open to mankind.

[1]Miller, G. Tyler Jr., *Living in the Environment*, Concepts, Problems, and Alternatives, Wadsworth Publishing Co., Inc., Belmont, Calif., 1975, pp. 8-9.

Activity Sketch

☐ ***Learning Objective:*** *Students will understand the demographic measures - birth rate, rate of population growth, infant mortality rate, life expectancy, and per capita gross national product - and be able to use them in comparing and contrasting the world's ten most populous countries in 1976.*

What is life like for the four billion inhabitants of the earth? Is there any correlation between a country's size and growth rate and the quality of life of its people? The *1976 World Population Data Sheet* from the Population Reference Bureau has a wealth of information which is used in this issue to show the similarities and differences among the world's ten largest countries. (See the Sources and Resources section on the *1976 Data Sheet.*) The bar graphs above illustrate five of 12 measures listed on the *Data Sheet* for a total of 161 countries. Such graphs are very useful for displaying data.

Five widely-used measures shown in the bar graphs are birth rates, rates of population growth, infant mortality rates, life expectancy, and per capita gross national product. These measures are averages which are useful in comparing countries. Averages, however, indicate nothing about what real differences there may be within a particular country and often conceal disparities.

Birth Rate. The annual number of births per 1,000 people is the birth rate and is a key factor in population growth. Most developed countries have low birth and death rates while most developing countries have high birth rates and declining death rates. For example in 1976, the United States with a low birth rate of 15 and a low death rate of nine is growing at less than 1 percent. Brazil, on the other hand, with a high birth rate of 37 and a low death rate of nine is growing at a rate of 2.8 percent each year.

Rate of Population Growth. The annual rate of natural increase (birth rate minus the death rate) combined with net migration determines country rates of population growth. This growth rate is always given as a percent and is one of the most frequently used demographic measures. The world's population growth rate in 1976 is 1.8 percent, but the range extends from a low of 0.1 percent in the United Kingdom and Austria to a high of 5.9 in Kuwait. High rates of growth, characteristic of the developing countries, result in more hungry, ill-clothed, unemployed, and illiterate people.

Infant Mortality Rate. Variations in the chances that a baby will live to his or her first birthday perhaps best reflect the inequalities among the world's 4 billion inhabitants. Developing countries are plagued with high infant mortality rates (the annual number of deaths to infants under one year of age per 1,000 live births). In Nigeria, for example, of every 1,000 children born, 180 will die before they are a year old. In Japan that number would be 11. The United States, with an infant mortality rate of 17, lags somewhat behind other nations such as Spain and Sweden in this measure of social and physical well-being.

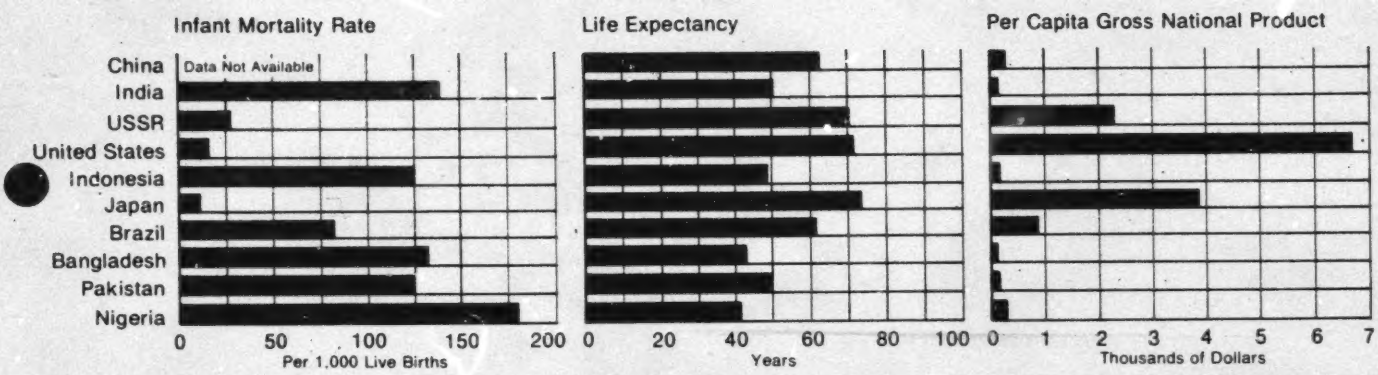
Life Expectancy. The number of years a new-born child can expect to live is called life expectancy. The first year of life is the most critical in determining this measure of longevity. Generally, a lower level of infant mortality is associated with longer life expectancy. Compare the infant mortality and life expectancy rates of the USSR, United States and Japan, with those of Indonesia, Bangladesh, and Pakistan.

Per Capita Gross National Product. The Per Capita Gross National Product (GNP) represents the average income per person in a country. Generally, countries with high rates of population growth have low average incomes. In the charts above, India, Indonesia, Brazil, Bangladesh, Pakistan, and Nigeria with the highest population growth rates have the lowest per capita GNP. As with other average measures, per capita GNP reveals nothing about the distribution of wealth among a country's people, and unequal distribution of income is common among the poorer countries. For

ESTIMATED POPULATION OF THE WORLD'S TEN LARGEST COUNTRIES
(IN MILLIONS)

1932		1976		2000	
1. China	425	China	837	China	1126
2. India (Br)	360	India	621	India	1051
3. USSR	160	USSR	257	USSR	314
4. United States	125	United States	215	United States	263
5. Japan	66	Indonesia	135	Indonesia	230
6. Germany	66	Japan	112	Brazil	208
7. Indonesia (Neth)	63	Brazil	110	Pakistan	146
8. United Kingdom	46	Bangladesh	76	Bangladesh	145
9. France	42	Pakistan	73	Nigeria	135
10. Italy	42	Nigeria	65	Mexico	134

Source: 1932: *Demographic Yearbook, 1948*, United Nations, New York, 1949. 1976 and 2000: *1976 World Population Data Sheet*, Population Reference Bureau, Inc.



example, in Nigeria, where the per capita GNP is only $130 per year, the poorest 60 percent of the population earn about 23 percent of the nation's wealth, while the top five percent control over 38 percent. Such an unbalanced distribution of income reflects imbalances in education and job opportunities.

For Discussion: What is the apparent relationship between birth and infant mortality rates? Between birth rates and the per capita GNP? Between life expectancy and GNP? Are there any surprises among the countries listed as the ten most populous? Which one(s) and why? Notice in the table Estimated Population of the World's Ten Largest Countries that the projections for the year 2000 show Japan as the only country dropping out of the "top ten." Explain why that is so. Discuss also the reasons for Germany, France, Italy, and the United Kingdom being among the most populous in 1932 but not in 1976.

☐ ***Learning Objective:*** *Through riddles, students will grasp the enormity of a billion, and the concepts of doubling time and exponential growth.*

1. How many is a billion people? Is it possible to gain an understanding of how many that really is? Present the following riddle to your students. "Your rich uncle has just died and has left you $1 billion. But if you accept the money you must count it for eight hours a day at the rate of $1 per second. When you are finished counting, the $1 billion is yours and then you may start to spend it. Do you accept your uncle's offer?" (Most students will probably reply, "Sure!" But after doing the math, few are ready to spend 95 years counting!)

2. To demonstrate doubling times and exponential growth, give the students mimeographed calendars along with bags of rice to represent pennies. Then ask the students to solve the following riddle: A father complained that his son's allowance of $5 per week was too much. The son replied, "Okay, Dad. How about this? You give me a penny for the first day of the month, 2¢ for the next, 4¢ for the next, 8¢ for the next, and so on for every day of the month." The father, thinking he had a foolish son, readily consented. Who was the wiser? (Look on the last page of this issue for the answer.)

Sources and Resources

1976 World Population Data Sheet, Population Reference Bureau, Inc., 1754 N Street, N.W., Washington, D.C. 20036. 1 copy costs 50¢; 2–49 copies cost 35¢; over 50 copies cost 25¢. This is PRB's most popular publication containing basic demographic data for 161 countries. The demographic variables included for each country, region and the world are: the population estimate for mid-1976; birth, death, and infant mortality rates; population projection to 2000; rate of population growth; number of years to double population; percent of population under 15 years; life expectancy at birth; median age; percent urban population; and per capita gross national product. This is an extremely useful tool for classroom exercises.

Food for Thought, A Population Simulation Kit, is the updated and greatly expanded version of *Global Geography.* Jointly developed by the Population Institute, 110 Maryland Ave., N.E., Washington, D.C. 20002, and the Population Reference Bureau, Inc., 1754 N Street, N.W., Washington, D.C. 20036, it costs $3. This simulation is an outstanding success wherever it is undertaken. It can be adapted to a wide range of audiences and can be lengthened or shortened depending upon the time available. *Food for Thought* is designed to foster understanding of some of the relationships, problems, and consequences involved in population growth and distribution of people, food, and land area.

World Watch Paper 5, Twenty-Two Dimensions of the Population Problem, by Lester R. Brown, Patricia L. McGrath, and Bruce Stokes. Available from the Worldwatch Institute, 1776 Massachusetts Avenue, NW., Washington, D.C. 20036. March, 1976. $2. This is the latest in a series of papers on contemporary social issues. The effect of population growth on 22 areas, from literacy, ocean fisheries, and natural recreation resources to endangered species, energy and individual freedom, are discussed. Selected readings round out the book, making it a brief overview of many population-related concerns.

Habitat Resource Bulletin, from the Organization Liaison Division of the Population Institute, 110 Maryland Avenue, N.E., Washington, D.C. 20002, Rebecca Davison, editor. Single copies free with self-addressed stamped envelope; 2-100 copies 10¢ each including postage; 101 or more copies 8¢ each. Geared to the UN HABITAT Conference, this newsletter contains an amazing amount of information in four pages including bibliographies, newsletters, and activities.

Population, Social Issues Resources Series, Inc., 1200 Quince Orchard Blvd., Gaithersburg, Md. 20760. $40 for an initial volume of 104 articles. An annual supplement of 20 articles is available for $10. This collection of population-related articles is reprinted from a wide variety of sources. A study guide gives suggestions on use of the volume. (Population is one of a series of volumes documenting problems of today's society such as food, pollution, and energy.)

World Population, 3 min., color, available for $45 purchase, $10 rental from Coronet Instructional Media, 65 E. South Water St., Chicago, Ill. 60601. This is a superb film that graphically illustrates population growth. Small dots appear on the continents tracing the growth and spread of population from 1 A.D. to the year 2000. The sound of a beating heart accelerates as population growth does. This film accomplishes in 3 minutes what longer films often don't do.

More PRB Texts

The response to *This Crowded World* and *People!* was overwhelming, and all copies have been distributed. You can receive multiple copies of *Options: A Study Guide to Population and the American Future* (grades 7-12) for postage only. The supply is also limited. Order immediately from PRB, 1754 N St. N.W., Washington, D.C. 20036.

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Field Focus

The 1975-76 school year has seen a burgeoning of population education workshop activity. The pop ed programs of Zero Population Growth, Inc. (ZPG) and the Population Reference Bureau, Inc. (PRB) are at the forefront of a coordinated effort to move the field in the United States from a theoretical to an ongoing program of study.

The ZPG sponsored workshop program is supported by grants from the U.S. Office of Environmental Education and the Sunnen Foundation. The purpose of the workshops is the integration of population into secondary school curricula in five target states. Key elements in the success of the program thus far have been the participation of state and locally based organizations and individuals as well as the provision of numerous pop ed materials. Workshops have been held in three states and have generated some interesting follow-through activities.

1. *Delaware:* In November 1975, 40 educators, primarily high school principals, met for a one-day workshop in Newark. Delaware based sponsors included the State Dept. of Public Instruction; Appoquinimink, New Castle-Gunning Bedford, and Newark School Districts; and the College of Education of the University of Delaware. The session was a unique effort to stimulate the interest of school principals.

The workshop generated the following activities: 1) a pop ed session for social studies and science teachers held in Newark in March, 2) a mailing to all Delaware social studies and science teachers of an annotated listing of population and environmental activities, lesson plans, and films available at the University, and 3) a three-week Population/Environmental Education Workshop to be conducted this summer at the University of Delaware. ZPG is providing the registration fee and will supply participants with sets of 100 lesson plans which have been developed by students at the College of Education.

2. *Florida:* Forty environmental educators and social studies and science supervisors gathered in Tallahassee for a two-day Environment and Population Workship in January. The State Office of Environmental Education and Florida State University were the local sponsors.

Spin-off activities include a workshop for teachers in Orlando planned for this summer; the adoption of a pop ed unit into the required geography curriculum in Pensacola, and the introduction of units into Caravelle and Ft. Myers.

3. *Ohio:* In February, 40 college of education and secondary school educators met in Cincinnati for a two-day session co-sponsored by the State Dept. of Education and the University of Cincinnati. The following activities have been generated as a result: 1) a one-week statewide workshop for college of education and secondary school educators will be held in June at the University, 2) a one-day workshop is planned for teachers on May 19 at Bowling Green University. Judy Dushane, workshop organizer, devoted a recent issue of *Ecocentric*, the statewide environmental education newsletter to pop ed, and 3) several participants at the February workshop serve as members of the State Commission on Environmental Education and are promoting the inclusion of pop ed in the State plan.

The pop ed program of PRB has become increasingly involved in organizing and participating in workshops. The following is a listing of some of these activities:

- National Council for the Social Studies, Atlanta, approx. 70 teachers attended the workshop and received materials at the November annual meeting. (A Pop Ed Clinic has been proposed for the 1976 NCSS annual meeting next November in Washington, D.C.)
- National Association of Secondary School Principals, Washington, D.C., 250 principals received materials at a pop ed exhibit, and a workshop was held at the annual meeting in February.
- National Association of Independent Schools, Boston, over 100 teachers received materials at a pop ed exhibit during the February annual meeting.
- National Science Teachers Association, Phila., approx. 500 teachers received materials at a pop ed exhibit and 150 attended a workshop at the March annual meeting.
- National Catholic Education Association, Chicago, 60 teachers attended a workshop at the April meeting.

Events Calendar

May 10-12 The Urban Life-Population Education Institute in Baltimore, Maryland, will conduct a three-day workshop for representatives of various states to introduce them to strategies for institutionalizing population education.

May 25 A population education workshop will be conducted for teachers in Bergen County, New Jersey

May 31–June 11 The United Nations sponsored conference, HABITAT, will be held in Vancouver, Canada.

June 2 A population education workshop for district supervisors, teachers, and education professors of science, social studies, and the humanities will be held at the Science Teaching Center, University of Maryland, College Park, Maryland.

Answer: The son's allowance

Day 1	.01	Day 16	327.68
Day 2	.02	Day 17	655.36
Day 3	.04	Day 18	1,310.72
Day 4	.08	Day 19	2,621.44
Day 5	.16	Day 20	5,242.88
Day 6	.32	Day 21	10,485.76
Day 7	.64	Day 22	20,971.52
Day 8	1.28	Day 23	41,943.04
Day 9	2.56	Day 24	83,886.08
Day 10	5.12	Day 25	167,772.16
Day 11	10.24	Day 26	335,544.32
Day 12	20.48	Day 27	671,088.64
Day 13	40.96	Day 28	1,342,177.28
Day 14	81.92	Day 29	2,684,354.56
Day 15	163.84	Day 30	5,368,709.12
		Day 31	$10,737,418.24

Interchange is . . .

a publication of the Population Reference Bureau, Inc. written by Judith Seltzer and Carol Fletcher. It is distributed free on request to educators and centers of population education activity. The purpose of this newsletter is to introduce the interdisciplinary nature of population information, provide classroom activity suggestions, and to review developments in the growing effort to infuse population issues into U.S. secondary schools. Interchange is dependent upon information and ideas from its readers to facilitate two-way communication. The authors openly solicit such an exchange.

The Population Reference Bureau, Inc., 1754 N Street, N.W., Washington, D.C. 20036, is a non-profit education organization established in 1929. The Bureau is a source of information on the facts and implications of national and world population trends. Through a special $5 membership, teachers receive Interchange, Population Bulletins, *the annual* World Population Data Sheet, PRB Reports, *and* Intercom.

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